CLAIMS

What is claimed is:

1. A method implemented by one or more processors, comprising:

receiving first information relating a plurality of flow rates of a species to corresponding concentrations of the species within films generated using the flow rates;

receiving a desired concentration profile of the species within a desired film; and

generating a plurality of process steps that, when performed, would form the desired film with the desired concentration profile by controlling the flow rate of the species based, in part, on the first information and the desired concentration profile,

wherein a first concentration of the species at a first point in the desired concentration profile differs from a second concentration of the species at a second point in the desired concentration profile.

2. The method of claim 1, wherein the first information relates at least three flow rates of the species to at least three determined concentrations of the species within films generated using the at least three flow rates.

3. The method of claim 2, wherein the first information defines a polynomial function.

4. The method of claim 3, wherein the polynomial function is derived by calculating a curve that fits the flow rates and determined concentrations.

5. The method of claim 4, wherein the polynomial function is derived using a Gauss-Jordan curve-fit algorithm.

6. The method of claim 1, further comprising forming the desired film with the desired concentration profile by performing the generated plurality of process steps.

7. The method of claim 1, further comprising:

receiving second information relating a second plurality of flow rates of the species to corresponding film growth rates;

wherein the plurality of process steps controls the flow rate of the species based, in part, on the second information.

8. The method of claim 7, wherein the second information relates at least three flow rates of the species to at least three measured growth rates of test films generated using the at least three flow rates.

9. The method of claim 8, wherein the second information defines a polynomial function.

10. The method of claim 9, wherein the polynomial function is derived by calculating a curve that fits the flow rates and measured film growth rates.

11. The method of claim 10, wherein the polynomial function is derived using a Gauss-Jordan curve-fit algorithm.

12. The method of claim 8, further comprising forming the desired film with the desired concentration profile by performing the plurality of process steps.

13. The method of claim 7, wherein generating by the one or more processors the plurality of process steps to form the desired film with the desired concentration profile comprises:

a) determining a desired concentration value for a point on the desired concentration profile;

b) using the first information to determine a first corresponding flow rate for the desired concentration value;

c) using the second information to determine a first corresponding growth rate for the first corresponding flow rate;

d) determining the thickness of a layer of the desired film that would be formed using the first corresponding flow rate and a predetermined time interval; and

e) using the determined thickness of the layer of the desired film to determine a next desired concentration value for a next point on the desired concentration profile.

14. The method of claim 13, further comprising repeating steps (b) through (e).

15. The method of claim 14, where the predetermined time interval is under one second.

16. The method of claim 15, wherein the predetermined time interval is approximately 0.2 seconds.

17. The method of claim 15, further comprising forming the desired film with the desired concentration profile by performing the plurality of process steps.

18. The method of claim 2, wherein generating by the one or more processors the plurality of process steps to form the desired film with the desired concentration profile comprises:

a) determining a desired concentration value for a point on the desired concentration profile;

b) using the first information to determine a first corresponding flow rate for the desired concentration value;

c) determining a first corresponding growth rate for the first corresponding flow rate;

d) determining the thickness of a layer of the desired film that would be formed using the first corresponding flow rate and a predetermined time interval; and

e) using the determined thickness of the layer of the desired film to determine a next desired concentration value for a next point on the desired concentration profile.

19. The method of claim 18, further comprising repeating steps (b) through (e).

20. The method of claim 19, wherein the predetermined time interval is under one second.

21. The method of claim 20, wherein the predetermined time interval is approximately 0.2 seconds.

22. The method of claim 21, further comprising forming the desired film with the desired concentration profile by performing the plurality of process steps.

23. A computer-readable medium carrying one or more sequences of one or more instructions, the one or more sequences of one or more instructions including instructions which, when executed by one or more processors, cause the one or more processors to perform:

receiving first information relating a plurality of flow rates of a species to corresponding concentrations of the species within films generated using the flow rates;

receiving a desired concentration profile of the species within a desired film; and

generating a plurality of process steps that, when performed, would form the desired film with the desired concentration profile by controlling the flow rate of the species based, in part, on the first information and the desired concentration profile,

wherein a first concentration of the species at a first point in the desired concentration profile differs from a second concentration of the species at a second point in the desired concentration profile.

24. The computer-readable medium of claim 23, wherein the first information relates at least three flow rates of the species to at least three determined concentrations of the species within films generated using the at least three flow rates.

25. The computer-readable medium of claim 24, wherein the first information defines a polynomial function.

26. The computer-readable medium of claim 25, wherein the polynomial function is derived by calculating a curve that fits the flow rates and determined concentrations.

27. The computer-readable medium of claim 26, wherein the polynomial function is derived using a Gauss-Jordan curve-fit algorithm.

28. The computer-readable medium of claim 23, wherein the one or more sequences of one or more instructions further comprise instructions which, when executed by the one or more processors, cause the one or more processors to perform:

receiving second information relating a second plurality of flow rates of the species to corresponding film growth rates;

wherein the plurality of process steps controls the flow rate of the species based, in part, on the second information.

29. The computer-readable medium of claim 28, wherein the second information relates at least three flow rates of the species to at least three measured growth rates of test films generated using the at least three flow rates.

30. The computer-readable medium of claim 29, wherein the second information defines a polynomial function.

31. The computer-readable medium of claim 30, wherein the polynomial function is derived by calculating a curve that fits the flow rates and measured film growth rates.

32. The computer-readable medium of claim 31, wherein the polynomial function is derived using a Gauss-Jordan curve-fit algorithm.

33. The computer-readable medium of claim 28, wherein generating the plurality of process steps to form the desired film with the desired concentration profile comprises:

a) determining a desired concentration value for a point on the desired concentration profile;

b) using the first information to determine a first corresponding flow rate for the desired concentration value;

c) using the second information to determine a first corresponding growth rate for the first corresponding flow rate;

d) determining the thickness of a layer of the desired film that would be formed using the first corresponding flow rate and a predetermined time interval; and

e) using the determined thickness of the layer of the desired film to determine a next desired concentration value for a next point on the desired concentration profile.

34. The computer-readable medium of claim 33, wherein the one or more sequences of one or more instructions further comprise instructions which, when executed by the one or more processors, cause the one or more processors to repeat steps (b) through (e).

35. The computer-readable medium of claim 34, wherein the predetermined time interval is under one second.

36. The computer-readable medium of claim 35, wherein the predetermined time interval is approximately 0.2 seconds.

37. The computer-readable medium of claim 24, wherein generating the plurality of process steps to form the desired film with the desired concentration profile comprises:

a) determining a desired concentration value for a point on the desired concentration profile;

b) using the first information to determine a first corresponding flow rate for the desired concentration value;

c) determining a first corresponding growth rate for the first corresponding flow rate;

d) determining the thickness of a layer of the desired film that would be formed using the first corresponding flow rate and a predetermined time interval; and

e) using the determined thickness of the layer of the desired film to determine a next desired concentration value for a next point on the desired concentration profile.

38. The computer-readable medium of claim 37, wherein the one or more sequences of one or more instructions further comprise instructions which, when executed by the one or more processors, cause the one or more processors to repeat steps (b) through (e).

39. The computer-readable medium of claim 38, wherein the predetermined time interval is under one second.

40. The computer-readable medium of claim 39, wherein the predetermined time interval is approximately 0.2 seconds.

41. A system comprising:

one or more processors;

a storage medium carrying one or more sequences of one or more instructions including instructions which, when executed by the one or more processors, cause the one or more processors to perform:

receiving first information relating a plurality of flow rates of a species to corresponding concentrations of the species within films generated using the flow rates;

receiving a desired concentration profile of the species within a desired film; and

generating a plurality of process steps that, when performed, would form the desired film with the desired concentration profile by controlling the flow rate of the species based, in part, on the first information and the desired concentration profile,

wherein a first concentration of the species at a first point in the desired concentration profile differs from a second concentration of the species at a second point in the desired concentration profile.

42. The system of claim 41, wherein the first information relates at least three flow rates of the species to at least three determined concentrations of the species within films generated using the at least three flow rates.

43. The system of claim 42, wherein the first information defines a polynomial function.

44. The system of claim 43, wherein the polynomial function is derived by calculating a curve that fits the flow rates and determined concentrations.

45. The system of claim 44, wherein the polynomial function is derived using a Gauss-Jordan curve-fit algorithm.

46. The system of claim 41, further comprising:

a chamber; and

one or more mass flow controllers,

wherein the mass flow controllers are coupled to the one or more processors and the chamber is coupled to the one or more mass flow controllers.

47. The system of claim 41, wherein the one or more sequences of one or more instructions further comprise instructions which, when executed by the one or more processors, cause the one or more processors to perform:

receiving second information relating a second plurality of flow rates of the species to corresponding film growth rates;

wherein the plurality of process steps controls the flow rate of the species based, in part, on the second information.

48. The system of claim 47, wherein the second information relates at least three flow rates of the species to at least three measured growth rates of test films generated using the at least three flow rates.

49. The system of claim 48, wherein the second information defines a polynomial function.

50. The system of claim 49, wherein the polynomial function is derived by calculating a curve that fits the flow rates and measured film growth rates.

51. The system of claim 50, wherein the polynomial function is derived using a Gauss-Jordan curve-fit algorithm.

52. The system of claim 48, further comprising:

a chamber; and

one or more mass flow controllers,

wherein the mass flow controllers are coupled to the one or more processors and the chamber is coupled to the one or more mass flow controllers.

53. The system of claim 47, wherein forming the desired film with the desired concentration profile comprises:

a) determining a desired concentration value for a point on the desired concentration profile;

b) using the first information to determine a first corresponding flow rate for the desired concentration value;

c) using the second information to determine a first corresponding growth rate for the first corresponding flow rate;

d) determining the thickness of a layer of the desired film that would be formed using the first corresponding flow rate and a predetermined time interval; and

e) using the determined thickness of the layer of the desired film to determine a next desired concentration value for a next point on the desired concentration profile.

54. The system of claim 53, wherein the one or more sequences of one or more instructions further comprise instructions which, when executed by the one or more processors, cause the one or more processors to repeat steps (b) through (e).

55. The system of claim 54, wherein the predetermined time interval is under one second.

56. The system of claim 55, wherein the predetermined time interval is approximately 0.2 seconds.

57. The system of claim 55, further comprising

a chamber; and

one or more mass flow controllers,

wherein the mass flow controllers are coupled to the one or more processors and the chamber is coupled to the one or more mass flow controllers.

58. The system of claim 42, wherein forming the desired film with the desired concentration profile comprises:

a) determining a desired concentration value for a point on the desired concentration profile;

b) using the first information to determine a first corresponding flow rate for the desired concentration value;

c) determining a first corresponding growth rate for the first corresponding flow rate;

d) determining the thickness of a layer of the desired film that would be formed using the first corresponding flow rate and a predetermined time interval; and

e) using the determined thickness of the layer of the desired film to determine a next desired concentration value for a next point on the desired concentration profile.

59. The system of claim 58, wherein the one or more sequences of one or more instructions further comprise instructions which, when executed by the one or more processors, cause the one or more processors to repeat steps (b) through (e).

60. The system of claim 59, wherein the predetermined time interval is under one second.

61. The system of claim 60, wherein the predetermined time interval is approximately 0.2 seconds.

62. The system of claim 61, further comprising:

a chamber; and

one or more mass flow controllers,

wherein the mass flow controllers are coupled to the one or more processors and the chamber is coupled to the one or more mass flow controllers.

63. An apparatus suitable for implementation by one or more processors comprising:

means for receiving first information relating a plurality of flow rates of a species to corresponding concentrations of the species within films generated using the flow rates;

means for receiving a desired concentration profile of a species within a desired film; and

means for generating a plurality of process steps that, when performed, would form the desired film with the desired concentration profile by controlling the flow rate of the species based, in part, on the first information and the desired concentration profile,

wherein a first concentration of the species at a first point in the desired concentration profile differs from a second concentration of the species at a second point in the desired concentration profile.

64. The apparatus of claim 63, wherein the first information relates at least three flow rates of the species to at least three determined concentrations of the species within films generated using the at least three flow rates.

65. The apparatus of claim 63, wherein the first information defines a polynomial function.

66. The apparatus of claim 63, wherein the polynomial function is derived by calculating a curve that fits the flow rates and determined concentrations.

67. The apparatus of claim 66, wherein the polynomial function is derived using a Gauss-Jordan curve-fit algorithm.

68. The apparatus of claim 63, further comprising a means for forming the desired film with the desired concentration profile by the generation means.

69. The apparatus of claim 63, further comprising:

means for receiving second information relating a second plurality of flow rates of the species to corresponding film growth rates;

wherein the plurality of process steps controls the flow rate of the species based, in part, on the second information.

70. The apparatus of claim 69, wherein the second information relates at least three flow rates of the species to at least three measured growth rates of test films generated using the at least three flow rates.

71. The apparatus of claim 70, wherein the second information defines a polynomial function.

72. The apparatus of claim 71, wherein the polynomial function is derived by calculating a curve that fits the flow rates and measured film growth rates.

73. The apparatus of claim 72, wherein the polynomial function is derived using a Gauss-Jordan curve-fit algorithm.

74. The apparatus of claim 70, further comprising means for forming the desired film with the desired concentration profile by performing the plurality of process steps.

75. The apparatus of claim 69, wherein the generating means comprises:

a) means for determining a desired concentration value for a point on the desired concentration profile;

b) means for determining a first corresponding flow rate for the desired concentration value using the first information;

c) means for determining a first corresponding growth rate for the first corresponding flow rate using the second information;

d) means for determining the thickness of a layer of the desired film that would be formed using the first corresponding flow rate and a predetermined time interval; and

e) means for determining a next desired concentration value for a next point on the desired concentration profile using the determined thickness of the layer of the desired film.

76. The apparatus of claim 75, further comprising means for repeating the functions performed by means (b) through (e).

77. The apparatus of claim 76, wherein the predetermined time interval is under one second.

78. The apparatus of claim 77, wherein the predetermined time interval is approximately 0.2 seconds.

79. The apparatus of claim 77, further comprising means for forming the desired film with the desired concentration profile by performing the plurality of process steps.

80. The apparatus of claim 64, wherein the means for generating the plurality of process steps to form the desired film with the desired concentration profile comprises:

a) means for determining a desired concentration value for a point on the desired concentration profile;

b) means for determining a first corresponding flow rate for the desired concentration value using the first information;

c) means for determining a first corresponding growth rate for the first corresponding flow rate;

d) means for determining the thickness of a layer of the desired film that would be formed using the first corresponding flow rate and a predetermined time interval; and

e) means for determining a next desired concentration value for a next point on the desired concentration profile using the determined thickness of the layer of the desired film.

81. The apparatus of claim 80, further comprising means for repeating the functions performed by means (b) through (e).

82. The apparatus of claim 81, wherein the predetermined time interval is under one second.

83. The apparatus of claim 82, wherein the predetermined time interval is approximately 0.2 seconds.

84. The apparatus of claim 83, further comprising forming the desired film with the desired concentration profile by performing the plurality of process steps.